USING COMPRESSED GASES AND NOVEL LIQUIDS FOR LUBRICATION ON THE MARTIAN SURFACE

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THE MARTIAN CLIMATE

- Average temperature about –60 °C
- Summer highs about +20 °C
- Polar nights about -120 °C
- Principal atmospheric constituent CO_2
- Average atmospheric pressure 8 millbars

SOJOURNER ROVER

- Afternoon of July 30th, temperature reached –13 °C
- At night temperature dropped to –73 °C
- Sojourner designed for –100 °C
- Batteries and electronics heated by radioisotope units
- Wheel drives used ball bearings consisting of plastic balls, aluminum races and no lubrication
- Spent 3 months traveling over Mars, 12 times longer than originally designed.

The Martian Surface

- Did running water cause the erosion features (channels, gullies and valleys) on the Martian surface?
- Kenneth Tanaka and co-workers have provided evidence that liquid CO2 was responsible for Martian erosion.

Liquids of Interest for Lubrication Studies

- Isopropanol: liquid down to –85 °C. Vapor pressure 40 mbars at 20 °C
- 2-Butoxyethyl Acetate: liquid down to –64 °C. Vapor pressure 0.2 mbars 20 °C
- Fluoro-compound: liquid down to –70 °C. Vapor pressure 2.9 mbars at 25 °C

CO2 GELLATION

- Yale research team succeeded turning supercritical CO2 into gel form. Discovered a molecule that gelled supercritical CO2.
- This gellation process increased the viscosity of CO2 ten-fold.
- New research under way to extend gellation to gaseous and liquid CO2
- Thickener molecules consisting of CO2-philic functionalities including siloxanes, fluoroethers, and fluoro-acrylates.